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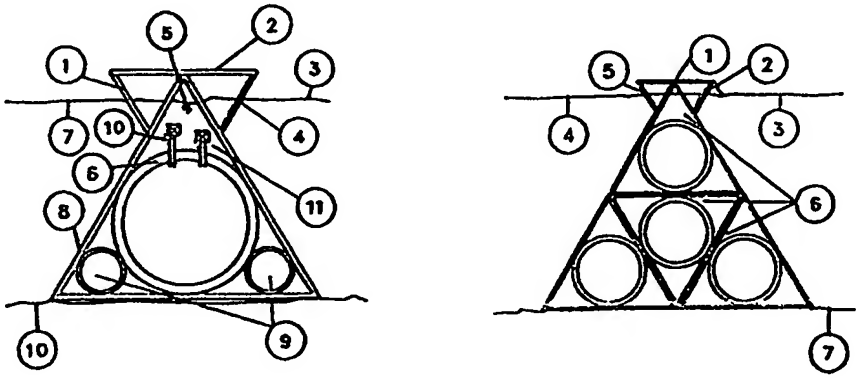

(57) Abstract

This technique enables to build harbour structures such as breakwaters, protective sea walls or artificial reefs. These structures are modular and can be removed after their installation. This technique uses mostly cylinder–shaped solids (6) fitted in the structures which can be filled with water or emptied to sink or float. This enables to transport the structures by sea. Since the structures are modular, they can be joined together vertically and horizontally so that structures of almost any size can be built. One of the devices which can be built is a structure with a closed cylinder (6) made of concrete, with a steel network structure (8) around it. The entire structure is prism–shaped with a triangular base and has open or closed surfaces with panels. The modules are joined together by means of conventional systems. The use of conventional floats (9) guarantees maneuverability to the modules.

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DESCRIPTION

A TECHNIQUE AND A DEVICE FOR BUILDING PROTECTIVE SEA WALLS OR ARTIFICIAL REEFS MADE OF MODULAR PARTS

The above mentioned invention concerns a technique which enables to build removeable harbours and artificial reefs, it also makes seaworthy those parts that form the protective sea walls and artificial reefs. Such structures are currently built of stone walls and reinforced concrete and for this reason they are fixed structures very expensive to construct. The existing removeable structures are floating ones and are composed of breakwaters, which are built using different systems, however none of them has the features of a conventional protective sea wall, in fact they can be placed where water is calm such as lakes and never in open sea. This technique enables to transport by sea the parts which form the installation, thus reducing production costs, in fact such structures are built in yards and then transported by sea to the points of installation. Since all parts are modular and already finished, less time is required to install this structure thus reducing costs. The modular parts which form the structure can float and be sunk the moment they are put in place; they can float again in case the structure has to be removed. This technique enables to build structures of almost any dimension such as breakwater dams, harbour protective sea walls, artificial reefs, driveways for lakes, long-distance power lines which can be submerged on seabeds and be inspected, practicable tunnels which can be also submerged on seabeds. This technique enables to build removable and reusable structures which are environmentally friendly, furthermore thanks to their particular shape they can shelter many sea species improving this way the quality of the sea environment. This technique enables to build structures which are not entirely closed so that water can flow in and flow out without stagnating in the basin. The technique consists of modular parts with a cylinder-shaped closed part in the middle (this cylinder-shaped part can be made of reinforced or prestressed concrete, iron or of several other compound materials). The cylinder-shaped part is fitted in a steel open network structure or in a part panelled structure according to the requirements. Such a structure forms triangular-shaped sections and a solid with two triangular sides and three rectangular sides with closed or open (only network structures) surfaces. The cylinder-shaped part in the network structure is watertight and thanks to valves it can be emptied so it can float or it can be filled with water or other liquids so that the module can sink. The empty areas between the network structure and the cylinder-shaped part or external to these are fitted with extra floats which increase the floating of the entire module

during trasport by sea. Thanks to these extra floats the module can be rotated when it has to be placed. According to requirements the modules can have different dimension. Thanks to its particular shape the system has a great resistance and structures of almost any dimension can be built. Resistance and supporting surface are increased in proportion by the size of the system. The various modular parts of the system can be hooked together during transport by sea and towed to the point where they have to be positioned. The various parts which compose the system are anchored to the seabed by means of drilling or ballast. The levelling of the supporting area is carried out by means of tetrahedral shaped parts which are anchored to the seabed and joined to the knots of the network structure forming the modules. First are placed the anchor parts and the tetrahedral shaped (or other shaped parts) parts in order to level the supporting area of the seabed) after the modules are sunk and placed on the supports, they are then connected together so that the structure is completed. Thanks to the extra floats the modules can be put in position while submerged. The entire structure can be dismantled disconneting one module at a time. It is possible to make the module float by pumping compressed air into the cylinder-shaped part so that water flows out of it. Rotation of the module and additional floating can be achieved by fitting extra floats. The valves fitted on the cylinder-shaped part for pumping air and filling it are of conventional type. The modules are prefabricated and can be used to build breakwater dams, harbour protective sea walls, wharfs, artificial reefs and also driveways for lakes or for water reservoirs subject to flooding. This techique enables also to build cable lines or long distance power lines or practicable tunnels on seabeds. In this case to the modules are added three closed cylinders (made of reinforced or prestressed concrete, of steel or of compound materials) which are fitted in the three vertexes of the triangle. The cylinders can be filled with air or water and be emptied again if the module has to be transported, sunk, placed or demounted and transported again. In case that cable lines, long-distance power lines or practicable tunnels resting on seabeds have to be built with the techique, the core in the middle (made of reinforced or prestressed concrete, of steel or other compound materials) is also cylinder-shaped with basements that enable to insert a cylinder of one module into another one, the basements are open and can be joined together by a male-female connecting system. This system has a conventional watertight and pressure seal system (gaskets and seals), parts of this system are connected together by bolts or by other conventional systems. The following passage is a further description of the invention in its industrial form, there is a reference to illustrations of some shapes that can be built using the technique of the invention:

Illustration 1: This illustration shows the device in section. The drawing shows in particular the cylinder 6, the contour of the network structure 8, the conventional extra floats 9 which are inserted in the vertexes and can be also inserted in the area of the vertex 5, the line of the seabed 10, the

waterline 7 and 3. The closed cylinder 6 is fitted with conventional valves 10, that enable to fill it with water. Once filled with water the module can float sink and rest on the seabed 10. The floats 9 are fitted with conventional systems that enable it be defleated or filled with water. In this illustration one can see the walkway 2 supported by the structure 1, since only one modular part is enough to reach the waterline 3 and 7. If the wave motion comes from the side of waterline 3 towards direction 3-7, this motion is diminished by the bulkhead 4, wich splits up the wave motion between the bulkhead and the surface of the cylinder 6. This module is linked to the seabed 10 by means of conventional systems which are fitted on the vertexes of the network structure. The device can be disconnected from the seabed. In fact once that the structure has been set free by the restraints fitted at the vertexes on the seabed 10, by pumping air into the valves of conventional type 10 water flows out from the valves of conventional type 11. At this point the structure can float and be towed away from the installation point.

Illustration 2: This illustration shows a side view of the device. The drawing shows the closed cylinder 4, the network structure 3, the bulkead 1 and the network structure of the walkway 2. This illustration is a side view of the device that is showed in illustration 1. The device is not fitted with the walkways described in illustration 1 and 2 if the modules are positioned under waterline.

Illustration 3: This illustration shows in section several modules joined together. The drawing shows in particular the seabed 7, the waterline 3 and 4, the structure of the walkway 1, the bulkhead 2 which interrupts the motion coming from the waterline 3 and the empy areas 6 which enable water to recirculate in the area of the waterline 4 that is protected by the wave motion. This picture shows how the device can be used when water is deeper than the height of a single module.

Illustration 4: This illustration shows (in section) the device as in illustration 3 and how it can be used when water is deeper than in illustration 3 and wave motion is very strong. The wave motion moves from waterline 2 to waterline 3 and it is deflected by the bulkhead 1 towards the cylinders positioned in the bottom. The illustration shows the tetrahedral-shaped supports 4 of the structure which are fixed to the seabed by means of conventional system and are placed exactly at the vertexes of the network structure. These tetrahedral-shaped supports can be of different size and be used if it is necessary to level the seabed to the above waterline. In case of sandy seabeds these supports are much bigger because a sizeable part of them has to buried in order to guarantee fastening to them and the structure. In case of rocky seabeds these supports are fixed to the stone by means of conventional systems. If one module is joined lenghtwise together to another one or to several other ones, it is possible to build structures of almost any lenght. In this case the modules are first joined together with the vertex bases that coincide with the vertexes of the tetrahedral-shaped parts 4 and then all the other modules in height and in width.

Illustration 5: This illustration shows in section the floats 3 of the device. These floats are made by means of conventional systems and enable to stabilize the module when it is floating or during transport. They enable also to rotate the module in the direction 1-2 when it is submerged in order to maximize maneuverability when it has to be put in place. The illustration shows also the cylinder 5, the network structure 6 and the waterline 4.

Illustration 6: This illustration fits the description of illustration 1 . The difference is the network structure 3 which is square-shaped in section. This illustration shows in section the closed cylinder 1, the waterlines 2 and 4, the bulkhead 6 and the seabed 5.

Illustration 7: This illustration shows triangular-shaped and square-shaped modules joined together to form the device. It also shows the waterlines 1-2 and the seabed 3.

Illustration 8: In this illustration the cylinder 5 is not filled with water so it can sink, but it is watertight. This enables to build inside the cylinder praticable tunnels or cable lines. The module can be sunk or float by means of the closed cylinders 2 and by conventional systems of water filling and emptying. In such a case the module rests or it is fastened to the seabed 6 and lies under the waterline 7. The contour structure is network-shaped and is made of steel like the above mentioned structures.

The closed or open cylinders can be made of reinforced or presssed concrete, of steel or of compoud materials like the above metioned devices. Rotation of the module can be obtained as described in illustration 5.

Illustration 9: This illustration shows a side view of the end parts of a module inserted in another one so that cylinder 8 is continuous.

This illustrations shows the male joints 9 for the cylinder 8 and the female joints 10 for the cylinder 11. If the module is moved in direction 7 then the cylinder 7 fits in by means of the joints 9 and 10 to the cylinder 11. The joints 9 and 10 are sealed with conventionale gaskets and sealing materials. The connection of several modules enables to build structures of almost any lenght.

Claims

1. A technique which enables to build protective sea walls, breakwater dams, artificial reefs by means of floating and seaworthy structures. The structures are put in place by sinking them, they can be removed, float again and reused.

2. A technique in conformity with claiming 1. The hallmark of this technique is that it enables to sink or float the structure by filling or emptyng a solid body with water

3. A technique in conformity with claimings 1 and 2. The hallmark of this technique is that the floating solid body is closed and cylinder-shaped or closed, prism-shaped with a polygonal base.

4. A technique in conformity with claimings 1-2 and 3. The hallmark of this technique is that it enables also to build submerged long-distance power lines, cable lines or tunnels which can be placed on seabeds.

5. A technique in conformity with claimings 1-2-3 and 4. The hallmark of this technique is that it enables to join several modules. The structure enables to regulate the flow of the sea currents by removing or adding the cylinder-shaped parts fitted in the modules.

6. A technique in conformity with claimings 1-2-3-4 and 5. The hallmark of this technique is that the modules are joined together and the cylinder-shaped parts are not filled with water. This enables to build floating walkways.

7. A technique in conformity with claimings 1 to 6. What distinguishes this technique is the fact during the construction of the floating wharfs the cylinders fitted in the modules can be partially filled with water. This enables to raise or sink the waterline of the wharfs and ballast them.

8. A device in conformity with claiming from 1 to 7. The conventional valves fitted on the closed cylinder-shaped tank, which enable to fill with water or empty it, dintinguish this device.

9. A device in conformity with claiming 8. The contour network-shaped structure of the cylinder

made of steel or other conventional materials distinguishes this device.

10. A device in conformity with claiming 9. The possibility that a great number of modules can be joined together in length and vertically distinguishes this device.

11. A device in conformity with claimings from 1 to 10. What distinguishes this device is the central core of the structure, in fact it is not cylinder-shape, but a solid with a triangular or a square or a polygonal base.

12. A device in conformity with claimings from 1 to 11. The hallmark of this device is that the modules can be joined together by means of bolts, bands and other conventional systems.

13. A device in conformity with claimings from 1 to 12. The hallmark of this device is that modules which have different shapes and dimension can be joined together.

14. A device in conformity with claimings from 1 to 13. The rotation of module in water achieved by means of conventional floats distinguishes this device.

15. A device in conformity with claimings from 1 to 14. The hallmark of this device is that the modules are seaworthy, can be joined together and towed to the position where they have to be sunk and placed.

16. A device in conformity with claimings from1 to 15. The presence of empty areas in the structure dinstinguishes this device. Thanks to these areas, in the basin that is marked by the structure, water can circulate and not stagnate.

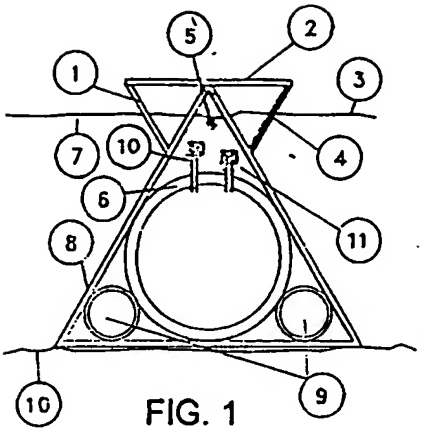

FIG. 1

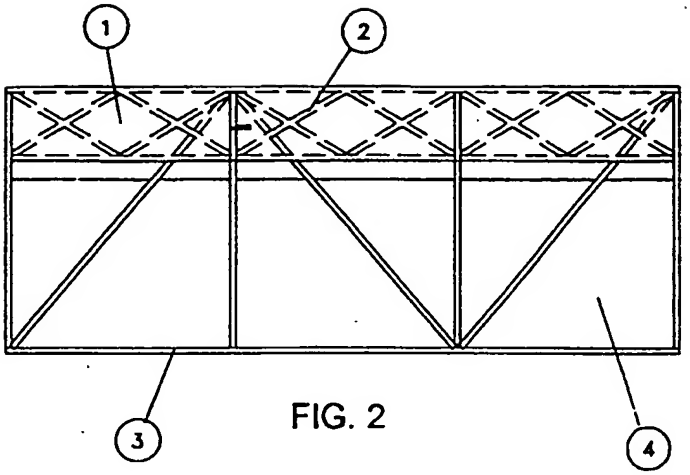

FIG. 2

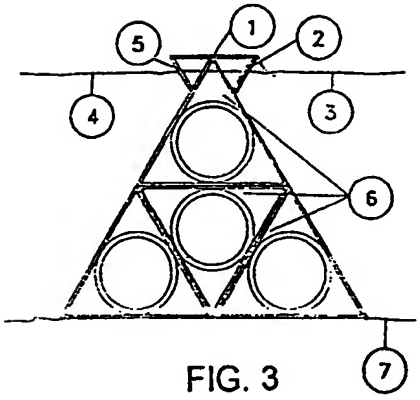

FIG. 3

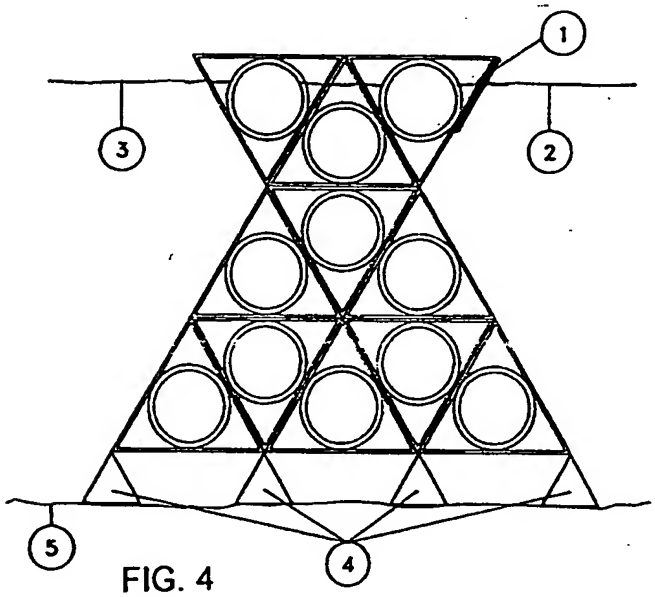

FIG. 4

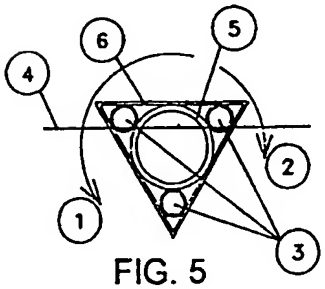

FIG. 5

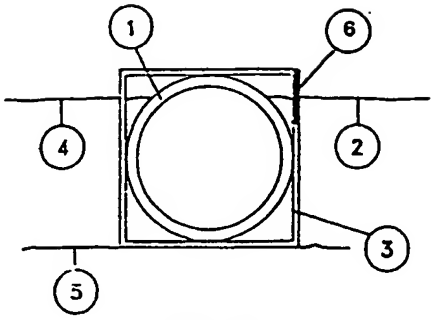

FIG. 6

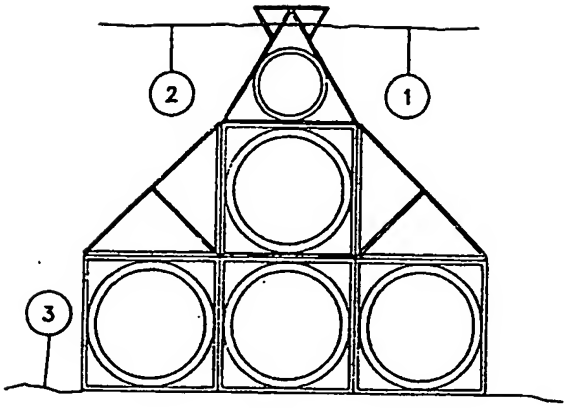

FIG. 7

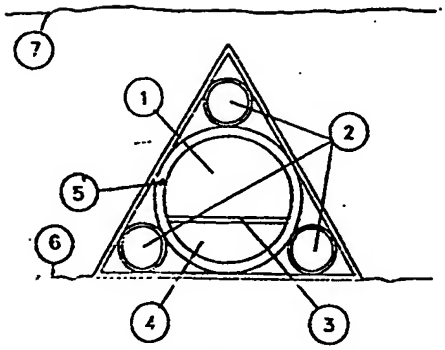

FIG. 8

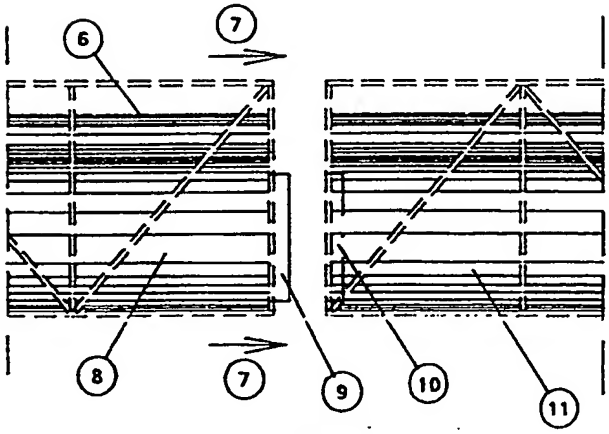

FIG. 9

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E02B3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 061 122 A (CHATTEY NIGEL) 29 October 1991 (1991-10-29)	1-3
A	column 4, line 3 - line 20 column 6, line 12 - line 60 column 7, line 55 - column 8, line 8; figures 2,5,6	5,8,9, 11-13,15
A	US 4 979 453 A (SLOAN STEPHEN ET AL) 25 December 1990 (1990-12-25) column 2, line 61 - column 3, line 21 column 3, line 59 - column 4, line 5 figures 3,10A	3,6-9, 12,16

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[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 September 1999	16/09/1999

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BE 637 175 A (S.E.G.A.N.S.) 31 December 1963 (1963-12-31) page 2, line 3 - line 27 figure 1	4
A	US 4 074 497 A (ONO TAISABURO) 21 February 1978 (1978-02-21) column 2, line 14 - line 39 figures 3,5	5,9,10, 12,13,16
A	US 1 846 278 A (ROANE ROBERT ROYAL) 23 February 1932 (1932-02-23) figure 3	6,9,12

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IT 99/00115

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